GOVERNOR'S DROUGHT TASK FORCE
IRRIGATED AGRICULTURE WORK GROUP

Agricultural Water Conservation

An Excerpt from the Draft Full Work Group Report

for review by the Governor's Drought Task Force

September 28, 2004

Forward

This document is a verbatim excerpt from the full 88-page Draft Irrigated Agriculture Work Group Report to the Governor's Drought Management Task Force. It is presented under separate cover because of the emphasis placed by the Governor on conservation in her Executive Order 2003-12, establishing the Arizona Drought Task Force, on March 20, 2003. Discussion, findings, and recommendations are based primarily on a survey of irrigation district managers. Other supporting data include interviews with members of Arizona's irrigated agriculture community, reports and papers submitted to the Work Group, a series of public meetings, and anecdotal information. The present text can also be found on this web site, in Chapter V of the full Work Group Report.

Agricultural Water Conservation And Drought Preparedness And Response

Introduction

The Governor's Executive Order specifically directs the Drought Task Force to

> "Evaluate opportunities for more efficient use of water to meet agricultural and municipal needs...Agriculture (work group) shall make assessments and develop mitigation strategies including opportunities to increase water use efficiency for drought related impacts on agriculture including crops and livestock"

Without doubt, conservation is an important element in drought preparedness and response and warrants measured attention as a part of Arizona's Drought Plan. We discuss conservation and increased water use efficiency as long-term drought preparedness and response options within the context of the Irrigated Agriculture Work Group Objective which reads in part,

> "....develop response, mitigation, and adaptation strategies to sustain the long-term economic viability of Arizona's irrigated agriculture."

So, the economic viability of Arizona's agricultural growth engine is paramount as the State prepares to manage eventual long-term drought. In other words, conservation as a drought response measure is not an end in itself, but is weighed within the larger context of sustaining the economic viability of the sector over the long-term.

Arizona is a state that experiences large variations in precipitation, some areas of the state receive an abundance of precipitation and others receive very little. The general lack of available moisture in many parts of the state requires that for agriculture to be a viable enterprise crops must be irrigated. Early development of the state occurred simultaneously with the development of surface water irrigation projects. These projects

caused lands to be put into production and cropped. Additional lands were added into production in the 1930s, 40s, and 50s as groundwater pump technology advanced and electricity became increasingly available.

Water for irrigated agriculture is a necessity whose cost to acquire and deliver to the field is a significant economic input into the farm budget. Because water is necessary and costly, irrigated agriculture has invested heavily in conservation measures, both on-farm and for delivery systems. These investments stretch limited supplies, increase profits, help manage situations of water supply scarcity, and help growers meet the conservation requirements of Arizona's 1980 ground water code.

Agricultural water users throughout the state have implemented physical on-farm conservation measures that include conveyance system and field irrigation system improvements. Examples of conveyance system improvements include lining ditches, piping, and installation of drain back systems. To efficiently and effectively utilize delivered water on fields, growers have invested heavily in field irrigation system improvements such as leveling, ditch lining, installing drip and sprinkler systems, and investing in tail water recovery and reuse systems.

To further maximize the efficiency of the water delivered to crops and to reduce the water necessary to meet crop needs, growers have implemented agronomic and water management practices. Examples of water management practices that are regularly implemented throughout the state include laser touch-up of fields, use of furrow checks, alternate row irrigation, contour farming, surge irrigation, use of temporary sprinklers, participation in both private and publicly sponsored water management services, soil moisture monitoring, and irrigation scheduling based on meteorological data. In addition, growers implement a series of agronomic management practices that help to conserve water. These practices include rotating crops, incorporating crop residue into the soil profile, soil and water quality testing, pre-irrigation surface conditioning, the use of transplants, mulching, shaping of furrows, and planting in the bottom of furrows.

Along with these on-farm conservation measures implemented by individual growers, agricultural water users, through membership in irrigation districts, have invested tens of millions of dollars in measures to efficiently distribute water through the larger irrigation distribution systems. One of the most significant, and most expensive, measures implemented by most irrigation districts to conserve water has been the lining of canals. To further conserve water, irrigation districts have invested in automated measuring and delivering systems and have implemented programs to maintain and improve the efficiency of water production wells. Several Arizona irrigation districts deliver water through underground pipelines. The Work Group estimates that hundreds of millions of dollars of such investments have been made in Arizona since the passage of Arizona's historic 1980 Water Code, however, precise data are not available.

Arizona Law establishes three agricultural water conservation programs, five active water management areas (AMA's), and three irrigation non-expansion areas (INA's). In the AMA's, growers must be regulated either under a base conservation program that uses

fixed not-to-exceed quantity water allotments or may choose to be regulated under an Historic Cropping Program or an Agricultural Best Management Program, established by statute in 2003.

Ongoing private, State, and Federal programs stimulate, motivate, and provide incentives to both physical and management water conservation practices. The Environmental Quality Improvement Program (EQIP) of the Natural Resources Conservation Service (NRCS) is one example. As outlined on the Table, next page, EQIP has been very popular with Arizona growers. Between 1997 and 2002, more that 55,000 cropland acres statewide were under treatment, while total EQIP funds requested in Arizona were $90.8 million over that same period, but just $32.1 million in EQIP Program funding was allocated to the State. Informal conversation with several NRCS District Conservationists indicates that EQIP cost-shares many of the irrigated agriculture physical practices discussed above, including field leveling, ditch lining, efficient gates, turnouts, and ports, sprinkler systems, and culverts. The State of Arizona offers the Agricultural Water Conservation System Tax Credit. It offers incentive tax credits for investment in these same types of physical system improvements, including ditch lining, pipelines, field leveling, sprinkler and trickle systems, and tail water recovery systems. The USDA Risk Management Agency (RMA) offers a Prevented Planting (drought) program as a part of its overall crop insurance programs (www.rma.usda.gov/news/2003/04/PreventedPlanting.pdf). Several district managers indicate that grower participation in this RMA Program was up sharply in 2003 and again in 2004.

An ongoing partnership between the Arizona Department of Water Resources, the Arizona Department of Agriculture, the NRCS, and the Bureau of Reclamation sponsors irrigation water management technical service providers who provide on-farm technical services. Their technical assistance is popular with growers, but limited by available staff time. They provide services including soil moisture monitoring, measurement of water applied, estimates of distribution and application efficiencies, estimates of run-off and deep percolation losses, cost analysis, conducting water management workshops, irrigation scheduling, testing pump efficiencies, and similar technical management services. Some irrigation districts sponsor the private sector provision of water management services. Private Certified Irrigation Specialists practice in Arizona's irrigated areas.

Survey Results – What Irrigation District Managers Say About the Potential of Conservation and Water Use Efficiency as Long-Term Drought Preparedness and Response Options

Our statewide survey of irrigation district managers listed thirteen water conservation drought preparedness and response items (see the Survey Section Annex to Chapter V in the full Work Group Report). All twenty-two district managers responded to at least one of these thirteen items. The table below summarizes district manager responses in three categories: Physical conservation practices; management conservation practices; and other practices.

Summary Information - Arizona EQIP Contracts

1999				
Land use	Number of Contracts	Amount ($1000)	% of Obligation	Acres Under Contract
Cropland	198	3146.8	61%	12329
Irrig. Pasture	23	221.2	4%	469
Rangeland	71	1822.5	35%	903451
Other	1	1.4	0%	4
Total	293	5191.9	100%	916253

2000				
Land use	Number of Contracts	Amount ($1000)	% of Obligation	Acres Under Contract
Cropland	126	2657.2	53%	8316
Irrig. Pasture	14	286.5	6%	2207
Rangeland	67	2038.8	41%	760746
Other				
Total	207	4982.5	100%	771269

2001				
Land use	Number of Contracts	Amount ($1000)	% of Obligation	Acres Under Contract
Cropland	135	3602.1	63%	12622
Irrig. Pasture	13	242.3	4%	602
Rangeland	60	1882.2	33%	532106
Other				
Total	208	5726.6	100%	545330

2002				
Land use	Number of Contracts	Amount ($1000)	% of Obligation	Acres Under Contract
Cropland	96	5743.8	56%	22249
Irrig. Pasture	32	830.7	8%	2113
Rangeland	64	3650.1	35%	991423
Other	2	58	1%	79
Total	194	10282.6	100%	1015864

Total funds requested since 1997 $ 90,800,155

Total funds allocated to Arizona since 1997 $ 32,137,550

Source: Data provided by Natural Resources Conservation Service

Conservation And Long-Term Drought Preparedness And Response

Conservation Practice	Already Available	No Help	Might Help	Potentially Important	Totals
Physical conservation practices *(five questions, 101 total responses)*	63	14	16	8	101
Management conservation practices *(four questions, 84 total responses)*	44	14	22	4	84
Other *(4 questions,82 total responses)*	19	20	29	14	82
- Greater water use efficiency *(n=22)*	7	4	4	7	22
- Use lower quality water *(n=20)*	2	8	8	2	20
- Study effect.–w.c. measures *(n=20)*	6	2	11	1	20
- Inc. acreage low water crops*(n=20)*	4	6	6	4	20

In this table, one response by one manager counts as one. For example, all 22 of the managers responded to the item, "Emphasize greater water use efficiency". Of the 22, seven said "Already available," four said "Would not help," four said "Might help some," and seven said "Potentially Very Important."

Physical Conservation Practices

The survey listed five physical conservation practices items:

- ✓ Use lasers for accurate land leveling
- ✓ Install return-flow systems
- ✓ Line canals or install piping to control seepage
- ✓ Use sprinkler and drip irrigation systems
- ✓ Install underground pipelines

The Work Group notes that these practices are generally included in the Arizona Best Management Practices – Agricultural Water Conservation Program categories of (1) Water Conveyance System Improvements, and (2) Farm Irrigation Systems. Altogether, 22 responding managers indicated 101 total responses to these 5 questions (because 110 or 5x22 total responses were possible, there were 9 non-responses).

Looking at the five physical practices, 77 of 101, or 76% of the total, said these were already available (63 responses) or would not help (14 responses). Only 24%, or 24 of 101, said these might help or were potentially very important. The responding districts can be sub-divided into those located within one of the State's five AMA's and those outside an AMA, as shown on the next chart.

Physical Conservation Practices and Location In or Not In an AMA

Location	Already Available, or No Help	Might Help, or Potentially Important
All locations *(five questions, 101 total responses)*	77 of *101*, or 76%	24 of *101*, or 24%
In an Active Management Area *(thirteen districts, 60 total responses)*	42 of *60*, or 70%	18 of *60*, or 30%
Not in an Active Management Area *(nine districts, 41 total responses)*	35 of *41*, or 85%	6 of *41*, or 15%

Thirteen responding districts were located in an AMA and nine were not. The AMA districts were somewhat more likely to regard the five physical conservation practices as potentially helpful in drought preparedness, with about 30% positive responses from the AMA districts versus 15% positive from the non-AMA districts. Statewide, whether in or outside of an AMA, about 60% of the responses indicated that these measures were already available.

These results should be taken in the context of the introductory discussion, that enormous statewide investments have already been made by Arizona's irrigated agriculture in both district and on-farm water conservation, and that incentive programs have been in place over many years in most of Arizona's irrigation districts. For those districts and growers who have yet to adopt these types of physical practices, a continuing attention to them may still hold some potential.

Management Conservation Practices
The survey listed four management conservation practices items:

- ✓ Schedule irrigation by crop water demand
- ✓ Schedule irrigation by soil moisture monitoring
- ✓ Improve tillage practices
- ✓ Use evaporation suppressants

The Work Group notes that these practices are generally included in Arizona's Best Management Practices – Agricultural Water Conservation Program categories (3) Irrigation Water Management, and (4) Agronomic Management. Altogether, the 22 managers indicated 84 responses to these four items (because 22x4 = 88 total responses were possible, there were 4 non-responses).

Looking at the four management practices, 58 of 84, or 69% of the total, said these were already available (44 responses) or would not help (14 responses). Only 26 of 84 (31%) said these might help or were potentially very important. The districts can again be sub-divided into those located within one or outside an AMA:

Management Conservation Practices and Location In or Not In an AMA

Location	Already Available, or No Help	Might Help, or Potentially Important
All locations *(four questions, 84 total responses)*	58 of *84*, or 69%	26 of *84*, or 31%
In an Active Management Area *(thirteen districts, 49 total responses)*	32 of *49*, or 65%	17 of *49*, or 35%
Not in an Active Management Area *(nine districts, 35 total responses)*	26 of *35*, or 74%	9 of *35*, or 26%

The AMA districts were again slightly more likely to regard the four management conservation practices as potentially helpful in drought preparedness, with about 35% positive responses from the AMA districts versus 26% positive from the non-AMA

districts. Overall, whether in or outside of an AMA, a majority of all responses indicated that these measures were already available.

This breakdown is similar to the response to the physical practices items. A majority of district managers may see limited conservation potential in management-type approaches, perhaps reflecting a view that the performance of most growers is already high in this area. Again, for the districts and growers who have yet to adopt these types of management practices, a continuing attention to them may still hold some potential.

Other Conservation Items
The survey listed four other conservation practices items:

- ✓ Emphasize greater water use efficiency
- ✓ Use lower quality water
- ✓ Study effectiveness of water conservation measures
- ✓ Increase acreage of low water using or drought-tolerant crops

Altogether, the 22 managers indicated 82 responses to these four items (because 88 total responses were possible, there were 6 non-responses).

Looking at the four practices, 39 of 82, or 48% of the total, said these were already available (19 responses) or would not help (20 responses), while 43 of 82, or 52% said these might help or were potentially very important. This breakdown is somewhat different than the 76-24 split evidenced in the physical and the 69-31 split in the management items. District managers may feel that there is somewhat more conservation potential in these ideas: The exact 50-50 split in response to "Emphasize greater water use efficiency" is illustrative.

Discussion: The Potential of Conservation and Water Use Efficiency as Long-Term Drought Preparedness and Response Options
Great progress has already been made in irrigation district and on-farm agricultural water conservation in Arizona. Again quoting one of the responding district managers:

> "As far as adaptation, the majority of farmers do everything economically possible to reduce water use, as it is their largest expense." (See Annex to Chapter V in the full Work Group Report)

Nonetheless, voluntary incentive programs focused on cost-shares, low-interest loans, and tax credits for physical conservation items undoubtedly do hold promise for some growers.

Voluntary water management-oriented programs such as irrigation mobile laboratories, Technical Service Providers (both private and public), and USDA/RMA Crop Insurance appear to have been effective and popular with growers and may also hold promise as longer-term drought preparedness options.

The approximate 50-50 split in views about the usefulness of 'other' conservation items is noteworthy. It may suggest other long-term preparedness possibilities for the State. Exactly half of the responding managers felt that emphasizing greater water use efficiency might help or was potentially important.

Discussion: Shorter-Term vs. Longer-Term Preparedness and Response
Consider a shorter time period of, say, 6-18 months vs. a longer time period of, say, two years or more. Effective or feasible preparedness and response measures over the shorter time frame may be much less feasible over the longer, and vice-versa. For example, a review of agricultural sector drought response measures **from other states** suggests possible adaptations such as the following:

- ✓ switch to lower water use crops
- ✓ reduce irrigated acreage
- ✓ switch to more drought tolerant crops
- ✓ lower target yields
- ✓ apply less water to the same area
- ✓ reduce water allotments/allocations
- ✓ grow crops with shorter maturity periods
- ✓ reduce acreage cropped in the summer and increase in the winter

The Irrigated Agriculture Work Group views these types of potential drought responses as short-term in nature. Essentially, they are forced responses to short-term emergencies. Some of this behavior did occur in some especially vulnerable Arizona irrigation districts in 2003, and is likely to occur again in 2004. Over a longer-term, these types of forced responses will not sustain the long-term economic viability of Arizona's irrigated agriculture. A quote from one of the responding managers is illustrative:

> "The statement on using drought tolerant crops has two major problems to overcome. There must be a demand for such crops and second financing becomes a big issue, as most growers use ginning co-ops for their current financial institution." (See Chapter V Annex in the full Work Group Report).

Economics – costs and returns – drive crop choice and acres planted. Water demand derives from those economic choices, which are also heavily influenced by Federal commodity programs and Arizona tax law. In Arizona, a forced short-term emergency approach to drought is likely to result not only in severe negative economic consequences on affected croplands, but also to engender severe negative secondary impacts on ginners, elevators, input dealers, and main street business whose economic well being is tied to a healthy, economically strong primary production sector. Preparedness for long-term drought might more productively focus on the vulnerabilities to drought analyzed in Chapter III of the full Work Group Report, and on the preparedness items that a majority of the responding district managers ranked as "might help," and "potentially very important" items.

Conclusions: The Potential of Increased Water Conservation As A Long-Term Drought Response In Arizona

Most promising conservation approaches:

- ✓ Expand physical and structural incentive programs such as EQIP, targeting the most vulnerable areas of the State and growers who may still benefit from voluntary participation in these programs.
- ✓ Broaden the reach of agronomic and irrigation water management and education programs, along the lines of ongoing private sector and ADA/ADWR/NRCS irrigation mobile lab and TSP programs and the Agricultural Water Conservation – Best Management Practices Program. Again, target the most vulnerable areas of the State and growers who may still benefit from voluntary participation.
- ✓ With a focus on preparedness, investigate the potential of tax credits, low-interest loans, drought insurance, and other incentives to conservation, along the lines of the existing Arizona Agricultural Water Conservation System Tax Credit program and the USDA/FSA Prevented Planting Crop Insurance Program.
- ✓ Support broader policy initiatives that show promise for Arizona: Maintain and modernize existing water facilities, support initiatives that allow existing water supplies to be used more effectively, use collaborative and voluntary market-based approaches, and lower institutional barriers to more effective water use.